

Comparison of Powered Toothbrushes and Manual Toothbrushes in Removing Dental Plaque among Children with hearing Disabilities: A Randomized Pilot Study



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OBJECTIVE: This study aimed to compare the effectiveness of plaque removal between manual and powered toothbrushes in hearing impaired children. Maintaining a good quality of life requires optimal levels of oral hygiene. In differently abled subjects, manual dexterity may be slightly compromised, which is why powered toothbrushes were initially designed to help overcome the slight deficit.

METHODOLOGY: A parallel arm, randomized study was conducted. Twenty two congenitally hearing-impaired participants aged eighteen to twenty two of age were recruited from National Special Education Centre for Hearing Impaired Children, Islamabad. They were randomly divided into two groups of eleven participants. Plaque levels were evaluated on the first day and plaque removal effectiveness of powered toothbrushes compared with manual toothbrush was checked on the eighth day. Plaque scores were evaluated using the simplified Oral Hygiene Index and Turesky's Modification of Quigley Hein Plaque Index.

RESULTS: No significant difference of Mean score in effectiveness of plaque removal between manual and powered toothbrushes was seen.

CONCLUSIONS: Manual and powered toothbrushes are equally effective at plaque. More studies highlighting cost effectiveness and patient's perception regarding ease of use are required to confirm results.

KEYWORDS: Differently abled patients, manual toothbrushes, electric toothbrushes, oral hygiene.

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INTRODUCTION

A disability may be defined as a condition which may be cognitive, developmental, intellectual, mental, physical or sensory. It considerably affects a person's day to day life and may be present at birth or occur anytime in life.¹ 3.28 million people were estimated to have disabilities in Pakistan according to 1998 census.

Data collected in 2015 showed that 2.49% of the population that year had disabilities.² The 2017 census showed that 0.48% of the Pakistani population has disabilities.³ A study done to evaluate the oral hygiene status of 4732 adults with learning and developmental disabilities reported an overall prevalence of periodontitis of 80.3%. The highest prevalence occurred in those over the age of 60 (92.6%) and the lowest (55.8%) in adults of 20 to 39 years of age.⁴ Dental health is neglected in the disabled population, leading to poor oral hygiene. The main reasons are lack of oral health awareness of guardians/caretakers, lack of motivation and insufficient training of dental staff.

Regular and consistent mechanical removal of plaque and food debris has been shown to decrease numbers of pathogenic bacteria. Plaque control can be achieved with tooth brushing twice daily and using interdental aids. Electric

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toothbrushes entered the consumer market in the early 1960s. Since then, many studies have been carried out to compare their plaque removal effectiveness with manual toothbrushes.^{5,6} Prevention of oral diseases in differently abled individuals is a challenging problem for dental professionals. They should be encouraged in their efforts to take care of themselves. Until now, several studies have concluded that there are deficits in balance, visual-motor skills and dynamic coordination in hearing impaired children.⁷

The main reason for choosing this population is because they are at a higher risk of developing tooth and gum disease. According to our hypothesis, electric toothbrushes are more effective in removing plaque as compared to manual toothbrushes in hearing impaired patients. According to our literature research conducted over a course of 6 months, no such study was found in Pakistan. The goal of this study is to analyze the effectiveness of powered toothbrushes to manual toothbrushes in individuals with hearing disabilities.

METHODOLOGY

A parallel arm, single blind, randomized, pilot study was conducted in National Special Education Centre for Hearing Impaired Children Islamabad. The data was collected from 24th and 31st January 2019. Ethical clearance was acquired from ethical committee of Riphah International University (Ref. No. IIDC/IRC/2018/04/002). The study was performed on twenty-two participants with congenital hearing disabilities. The sample size was estimated using nMaster software for hypothesis testing for two means (equal variances), WHO sample size calculator with confidence interval of 95%, Power of study 80% and level of statistical significance $P < 0.05$, $P_1 = 0.70$, $P_2 = 0.65$.

Informed consent was taken from the Head of the Institute and participants. The study procedure was explained to participants, their caretakers and in-charge staff and they were ensured confidentiality of their participation. Inclusion criteria was "subjects of both genders above sixteen years of age, who could brush on their own, are not taking any regular medications, have satisfactory general and oral health with no history of any systemic diseases." Exclusion criteria was "patients with orthodontic or prosthetic appliances, implants, using medication that would have an effect on gingival tissues, having any other oral and mucosal problems or more than four carious teeth requiring immediate treatment."

Participants were familiarized with manual and powered toothbrushes before commencement of the study with help of demonstrations using sign language. Our research was not sponsored by any toothbrush manufacturing company. Examiners responsible for data collection were trained

in the department of Periodontology, Islamic International Dental College. Turesky's Modification of Quigley-Hein Plaque Index was talked through with subject experts in order to remove ambiguities pertaining to scoring before the calibration procedure was begun. Twenty two patients were calibrated. Study subjects were allocated randomly when being examined, using Open Clinical Randomize software. (Fig 1.1) Allocation of participants was done by the co-principal investigator and assessment was done by the principal investigator. Oral examination was done using sterile instruments (explorer, probe, mirror, William's periodontal probe) under adequate illumination. Plaque, debris and calculus was evaluated on six sites on each tooth (distobuccal, mid-buccal, mesio-buccal, disto-lingual, mid-lingual, and mesiolingual). Third molars were excluded.

Eligible subjects were then randomized into two groups using OpenClinica Randomize software. (Fig 1.1). Oral hygiene kits containing manual toothbrushes and powered toothbrushes were coded A and B respectively, A (manual toothbrush) and B (powered toothbrush with rounded bristles and rotation oscillation action). Subject allocation and allotment of toothbrush kits was carried out by the co-principal investigator who was not involved in data collection procedure. Toothbrushes were labeled A and B and the investigator handing out toothbrushes to participants did not know whether A or B was manual or powered toothbrush. During manual brushing, the participants were instructed to use Modified Bass technique. Brushing techniques were demonstrated to participants as well as caretakers on a dental model. For powered toothbrush,

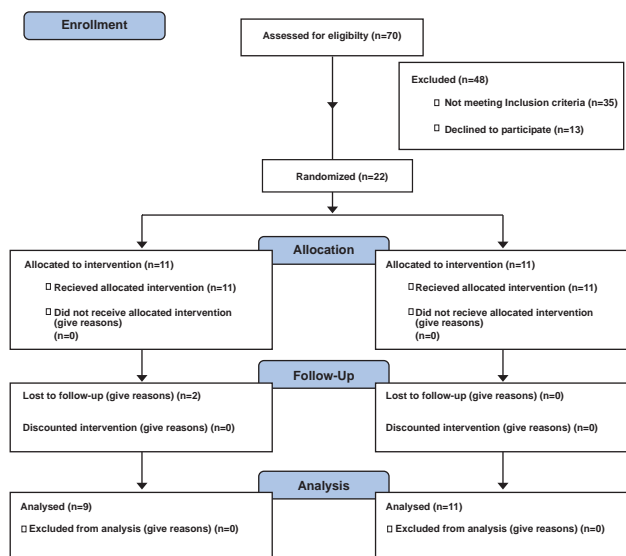


Fig 1.1: CONSORT flow diagram of recruitment, randomisation, allocation, follow-up, and analysis of subjects

participants were told to brush according to the instructions provided on the instruction manual by the manufacturer, a copy of which was provided to each participant. The duty to help participants recall the brushing technique was assigned to the caretakers. The same toothpaste containing sodium fluoride was provided to all students and they were told to brush two times daily for 2-3 minutes, using the toothbrush they were provided with. At the end, study participants were asked to carry out the toothbrushing technique for the satisfaction of examiners. Participants were assessed after one week. Clinical examination and scoring was performed by the same investigators blinded to the toothbrush being used.

Clinical evaluations were performed by the investigator who didn't know about allotment of the products and groups. Before start of follow-up examination, the co-principal investigator advised all participants not to expose their group task to the investigators. Evaluation of plaque on the first day was done by O'Leary method with explorer and mouth mirror according to criteria of Simplified Oral Hygiene Index (by Greene and Vermilion).⁸ On the eighth day the subjects were sent to the examination hall and the examiners used Turesky's Modification of Quigley-Hein plaque index for recording plaque scores.

SPSS version 23 (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp) was used to perform statistical analysis. The plaque score differed between the two groups, on the 1st day and the 8th day, which was compared using an independent sample t-test. Statistical significance was $P < 0.05$, $P_1 = 0.70$, $P_2 = 0.65$.

Oral Hygiene Index score (Appendix 1)⁹ was assessed at three sites per tooth by randomly selected quadrants by a single experienced and skilled examiner, who did not know the allotted groups. Presence of calculus and plaque (Turesky's Modification of Quigley-Hein plaque index) was evaluated in the same way. Visual inspection was done to assess the oral cavity at each visit and the students were properly trained before conducting the examination.

RESULTS

Demographics and Participants Information

The study included twenty two hearing impaired participants who were selected by a group of properly trained examiners after complete evaluation. The participants were studying in National Special Education Centre for Hearing Impaired Children, Islamabad and belonged to age bracket of 18-22 years. Majority of them belonged to the age group of 18 years ($n=7$) (31.8%). There were an

equal number of male ($n=11$) and female ($n=11$) participants. The participants had inadequate oral hygiene and brushed their teeth once daily prior to the study.

All subjects ($n=22$) successfully completed the study period of 8 days except 2 who were lost to follow up due to non-availability on the 8th day. There was no substantial difference in the mean age of the subjects.

Score For Manual Tooth Brush

The mean initial OHI-S value for manual toothbrush was 1.91 with a 0.2% of standard error, which reached a mean of 1.33 after the trial period of 8 days ($p < 0.05$). Evaluation of plaque and calculus showed a mean value of 1.27 and 0.69 at the start of the study which, after 8 days changed to 0.56 and 0.96 respectively. Mean debris index score was 1.07 at the start of the study and showed a significant decrease after 8 days (0.42). (Fig 1.2 and 1.3) Score for Powered Tooth Brush.

In the group using powered toothbrush, the mean baseline values of OHI-S and Debris index were 1.64 and 0.90 respectively, which later changed to 1.09 and 0.42 for OHI-S and Debris index. Plaque Index calculated at the start of our study showed a mean value of 1.36 and after 8 days it changed to 0.73. Whereas, calculus index showed a mean value of 0.63 at the start and 0.64 at the end of our

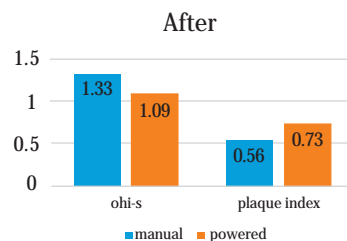


Fig 1: Bar graph showing difference in OHI-S and plaque index between manual and powered toothbrushes after 8 days

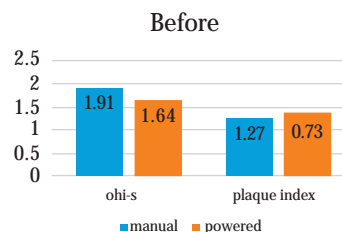


Fig 1.2: Bar graph showing difference in OHI-S and plaque index between manual and powered toothbrushes at the start of the study.

study. (Fig 1.2 and 1.3) A little difference was seen in the oral hygiene status of the students after 8 day trial period. (Table 1.1)

In this study, a powered toothbrush with rotatory action was compared to a regular manual toothbrush (having

Differences	Manual n=9	Powered n=11	P value
Calculus Index	0.19+0.64	0.01+0.43	0.18
Debris Index	0.72+0.7	0.48+0.65	0.50
Plaque Index	0.78+0.44	0.64+0.92	0.71
Oral Hygiene Index Score	0.67+0.71	0.55+0.93	0.94

Table.1: Differences in Mean (Calculus Index: Debris Index, Plaque Index and Oral Hygiene Index scores) of Manual and Electric Toothbrushes

Barriers to care faced by patients with special needs
Language barriers
Sensory impairments, such as vision and hearing problems
Psychological issues, such as low oral health literacy, dental anxiety and past negative experiences.
Limited transportation
Cultural barriers, such as health care providers with little training in cultural competency and/or treating patients with special needs.

Table 1.2: Barriers to care faced patients with special needs.

small head). The results of this 8 day trial period revealed that the toothbrushes had no significant effect on removal of debris and plaque when compared to each other but, following tooth brushing, twice daily, a significant reduction of plaque was seen.

DISCUSSION

WHO defines disability as "any restriction or lack (resulting from any impairment) of ability to perform activity in the manner or within the range considered normal for a human being". Of the total population of the world approximately 15% (about one billion) fit the aforementioned definition with a mild, moderate or severe nature. 93 million of these are children.¹⁰

People with disabilities face a lot of oral health discrepancies.¹¹ Oral health is ignored due to other serious systemic conditions, disability or limited access to healthcare. Furthermore, disabled people present specific challenges during oral health assessment due to their limited ability to perform certain functions and undergo oral examinations.¹² Modification to the treatment plan is required to provide adequate dental health care to such patients. There is a general unanimity that powered toothbrushes are equally safe as manual toothbrushes.¹³ To remove plaque buildup from teeth and gums, bristles of a powered toothbrush vibrate and rotate. The vibration consists of micro-movement every time the toothbrush is moved across the teeth.¹⁴ According to a study significantly different results are seen regarding effectiveness of powered toothbrush for plaque removal.¹⁵

The results of our study showed that there was no significant difference in plaque reduction between manual and powered toothbrushes (P value = 0.78) which clearly indicates that manual toothbrushes are as effective as powered toothbrushes even in disabled subjects. Turesky's modified Quigley-Hein index was utilized due to its ability to better assess plaque buildup as well as better assessment of interproximal areas for plaque.⁸ These results were comparable to the study done by Goyal et al, who also found there to be no significant difference in mean plaque scores in mentally disabled children (P > 0.05).¹⁴ Some clinical trials proved superiority of manual toothbrushes over powered¹⁶ showing inconsistency with our results. However, another study showed that, if used properly, manual toothbrushes were able to remove plaque effectively.¹⁷ A recent amendment of the Cochrane report on this topic concluded that the only type of powered toothbrush which removes more plaque than a manual toothbrush is one with rotational oscillatory movements.¹⁸ A few studies affirmed the advantage of powered toothbrushes over manual toothbrushes while other studies reported there to be no such difference.^{19,20}

In their systematic review, Vibhute and Vandana, statistically found no significant difference between powered and manual toothbrushes.²¹ Yaacob et al. in a systematic review found powered toothbrushes to be more successful in reducing plaque and decreasing gingivitis in comparison to manual toothbrushes.²² Difference in results might be because of larger sample size, decision of records, arrangement of dental prophylaxis during the investigation and diverse dissemination in groups.²³

In our study with manual and powered toothbrushes, after 8 days, mean plaque scores were 0.56 + 0.72 and 0.72 + 0.78 respectively. These results were lower than the results concluded by Neelima (1.93 ± 0.5 and 1.96 ± 0.4)²⁴ and Williams et al (post brushing manual = 0.62 ± 0.03, post brushing powered = 0.93 ± 0.03).²⁵ The differences in the results of our study with previous studies can be due to a number of reasons, such as; limited number of studies on subjects with disabilities, some of which are old or focused on old toothbrush technologies and have different methodologies such as choice of indices, differences in study design, selected populations and materials and methods. However, powered toothbrushes might be more beneficial in subjects who require help in brushing teeth due to limited dexterity and debilitation. Compliance was seen as acceptable with no antagonistic results reported in the current examination.

One of the limitations of this study was the small sample size and a limited duration of data collection. It is required that further research with a bigger sample size be done to have more accurate results.

CONCLUSION

Based on study, we concluded that Oral health is given low importance among special need subjects. This may be because of a dearth of oral health and hygiene awareness among parents or caregivers. We concluded that no notable difference was observed in plaque-removing effectiveness between powered and manual toothbrushes among differently abled participants in single brushing. We found a significant reduction in plaque post-brushing compared to pre-brushing in both these groups.

Keeping in mind all the factors that led to insignificant results, we suggest that trials having longer durations and larger sample size are required to get a more clear outcome. Furthermore, it is prudent to design oral health awareness programs focusing on the needs of the population with disabilities. This will not only reduce the burden on our health care system but will also reduce the cost of treatment and improve the quality of life of special needs individuals.

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CONFLICT OF INTEREST

None declared

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